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March 10, 2010 *Also Sent Via E-mail*

Mr. Robert J. Wyatt
NW Natural
220 N.W. Second Avenue
Portland, OR 97209

Subject: Remedial Investigation and Risk Assessment, NW Natural Property
NW Natural
Portland, Oregon
ECSI No. 84

Dear Mr. Wyatt:

The Department of Environmental Quality (DEQ) reviewed the following documents:

- "Remedial Investigation Report, NW Natural – Gasco Facility, Portland, Oregon," dated April 30, 2007 (RI Report); and
- "Revised Baseline Ecological and Human Health Risk Assessment Report," dated December, 2004 (Risk Assessment).

The RI Report presents the remedial investigation (RI) work completed by NW Natural from 1995 through 2005 to evaluate the lateral and vertical extent of manufactured gas plant (MGP) waste and associated contamination in soil and groundwater in the uplands of the property owned by NW Natural (NW Natural Property) and the adjoining Siltronic Corporation (Siltronic) owned property (Siltronic Property). Groundwater monitoring data is compiled through October 2006 in the document. The Risk Assessment evaluates the potential risk to human health and ecological receptors from exposure to MGP constituents on the NW Natural Property. The RI Report and Risk Assessment were prepared for NW Natural by Hahn and Associates, Inc. and Anchor QEA, LLC respectively.

During our review of the RI Report, DEQ considered information contained in other submittals prepared by NW Natural for the NW Natural Property, including primarily the Offshore Investigation Report[1], Groundwater/DNAPL Pilot Program Report[2], Environmental Monitoring Report(s)[3,4] (EMRs), and the results of downhole logging work completed using Targost®

[1] Anchor QEA, LLC, 2008, "Offshore Investigation Report, NW Natural 'Gasco Site'," February, a report prepared for NW Natural.
[2] Anchor QEA, LLC, 2007, "Groundwater/NAPL Pilot Program Extraction Well and Performance Evaluation Design Report," May, a report prepared for NW Natural.
[3] Hahn and Associates, Inc., 2009, "Environmental Monitoring Report, Summer 2007 through Spring 2008, NW Natural Facility 7900 NW St. Helens Road, Portland, Oregon," February 19, a report prepared for NW Natural.
[4] Hahn and Associates, Inc., 2009, "Environmental Monitoring Report, Third and Fouth Quarter 2008, NW Natural Facility 7900 NW St. Helens Road, Portland, Oregon," August 10, a report prepared for NW Natural.

equipment[5]. These documents postdate the RI Report and provide geologic and hydrogeologic information, and analytical data relevant to the uplands RI, as follows:

- The Offshore Investigation Report includes the results of two phases of in-water investigations conducted between October 2006 and September 2007, some of which were designed to evaluate the groundwater pathway from the uplands, out to and under the Willamette River.
- Groundwater/DNAPL Pilot Program Report and Summer 2007-Spring 2008 EMR, provide the results of physical and chemical testing data and boring logs for monitoring wells and pilot extraction wells completed along the shoreline of the NW Natural Property in February-March 2007 and June-July 2007 respectively.
- The EMR for the third and fourth quarters of 2008 provides a comprehensive tabulation of the groundwater monitoring data collected from monitoring wells on the NW Natural Property through September 2008.
- Targost® logging was conducted on the Gasco Site in August-September 2007 and March 2008 to assess the lateral and vertical extent of MGP dense non-aqueous phase liquid (DNAPL) along the shoreline of the NW Natural Property and northern portion of the Siltronic Property, and in and around former effluent ponds.

The work documented in the Offshore Investigation Report, Groundwater/DNAPL Pilot Program Report, and Targost® logging were conducted according to DEQ-approved work plans. References to additional sources of information are indicated in this letter as needed.

In addition to documents prepared by NW Natural, DEQ considered soil and groundwater data collected by the Army Corp of Engineers (ACOE) from the U.S. Moorings site. The U.S. Moorings facility adjoins the NW Natural Property to the north. The ACOE is conducting an RI of the site under U.S. Environmental Protection Agency (EPA) oversight.

The primary purpose of this letter is to inform NW Natural that based on our review of the RI Report, Risk Assessment, and supporting documents:

- DEQ accepts the RI Report and the supporting documents referenced above as satisfying the requirements of Voluntary Agreement No. WMCVC-NWR-94-13 (dated August 8, 1994) as amended by Addendum #1 dated July 19, 2006 (collectively referred to as the "MGP Agreement" in this letter) for an RI of the NW Natural Property.
- DEQ determines there are data gaps with regard to characterizing the nature and lateral and vertical extent of MGP contamination, but except as noted in DEQ's comments to the RI Report and Risk Assessment, uplands investigations have sufficiently characterized the NW Natural Property to support: 1) evaluations of potential risks to human health and ecological receptors from exposure to MGP waste and contamination, and 2) uplands removal action planning and feasibility study scoping. Additional data collection is warranted to further assess potential soil and groundwater contamination in the northern portion of the NW Natural Property and for completing the Risk Assessment. DEQ's recommendations for collecting data to complete the

[5] Hahn and Associates, Inc., 2008, "TarGOST Boring Information Transmittal, NW Natural Gasco Property, 7900 NW St. Helens Road; and Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon," July 8 (revised July 14, 2008), a data transmittal prepared for NW Natural.

Risk Assessment are provided in our comments to the Ecological Risk Assessment (ERA) and Human Health Risk Assessment (HHRA) below.

- DEQ does not accept the Risk Assessment and expects NW Natural to supplement site data, conduct an updated screening analysis of contaminants of interest (COI), incorporate the results into the ERA and HHRA, and revise and resubmit the document consistent with the comments detailed in this letter.

The remainder of the letter focuses on work completed on the NW Natural Property, including providing a brief background on the regulatory status, and DEQ's general and specific comments regarding the RI Report and Risk Assessment.

NW NATURAL PROPERTY STATUS

NW Natural prepared the RI Report and Risk Assessment for the NW Natural Property in partial satisfaction of the MGP Agreement. The MGP Agreement designates the NW Natural Property and adjoining property owned by the Siltronic Corporation (Siltronic Property) as the "Gasco Site." Under the MGP Agreement, NW Natural is expected to: 1) conduct an RI and feasibility study (FS) of releases of MGP waste[6] and associated contamination (MGP contamination) on the Gasco Site; and 2) identify and evaluate source control measures (SCMs) for unpermitted discharges or releases of hazardous substances from the NW Natural Property to the Willamette River. NW Natural's investigations of MGP contamination on the Siltronic Property are ongoing and being conducted under a work plan[7] approved by DEQ. The scope of work for the Siltronic MGP RI includes further assessment of the nature and extent of MGP waste and contamination and evaluation of potentially complete and/or significant human health and ecological exposure pathways in the uplands of the Siltronic Property and to offsite areas, including the Willamette River and Doane Creek.

In addition to the MGP Agreement, NW Natural is conducting work on the Gasco Site under DEQ Order No. ECVC-NWR-00-27 (the Joint Order) dated October 4, 2000. The Joint Order requires NW Natural and Siltronic to, "…identify, characterize, and evaluate any unpermitted discharge or migration of contaminants to the Willamette River or its sediments identified in the RI, and, as necessary, develop and implement source control measures to address such releases." Under the Joint Order and consistent with the Joint Source Control Strategy[8] (JSCS), DEQ considers NW Natural and Siltronic to be responsible for: 1) identifying complete contaminant transport pathways from the Siltronic Property to the Willamette River and sediment; and 2) evaluating SCMs alternatives for high priority pathways.

[6] MGP waste includes production waste and byproducts including, but not necessarily limited to, lampblack, purifier box wastes (spent lime and spent oxides), tar sludge, tar/oil/light oil, and tar/oil/water emulsions.
[7] Hahn and Associates, Inc., 2007, "Final Remedial Investigation Workplan, Historical Manufactured Gas Plant Activities - Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon," October 19, a work plan prepared for NW Natural.
[8] http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/jointsource.htm

Besides the Voluntary Agreement and Joint Order entered into with DEQ, NW Natural is also a party to Administrative Settlement Agreement and Order on Consent (Settlement Agreement; Docket No. CERCLA 10-2009-0255) with the EPA (AOC). NW Natural and Siltronic entered into the AOC on September 9, 2009. EPA determined cleanup of river sediments was warranted due to the presence of MGP waste and the concentrations of contaminants in river sediments adjacent to the NW Natural and Siltronic properties. Consistent with the AOC, NW Natural and Siltronic will conduct an Engineering Evaluation/Cost Analysis and design a final remedy for impacted sediments.

DEQ's comments to the RI Report and Risk Assessment are provided below. For clarification, the comments in this letter focus on the RI, ERA, and HHRA for the NW Natural Property portion of the Gasco Site. NW Natural's MGP site characterization work on the Siltronic Property is ongoing and has not progressed to the risk assessment. Given the status of RI work on the two properties, NW Natural is moving forward with the risk assessment and FS of the NW Natural Property separately. However, there are areas of significant MGP contamination on the NW Natural Property that overlap the northern portion of the Siltronic Property (e.g., former effluent pond). Based on this information, planning for removal and/or remedial actions on the NW Natural Property must consider contamination in the northern portion of the Siltronic Property.

DEQ's comments identify data gaps that need to be addressed to complete the RI, ERA, and HHRA, and/or deficiencies in the RI Report and Risk Assessment which should be addressed with supplemental information. The comments letter also clarifies DEQ's understanding or position regarding assertions and/or conclusions made by NW Natural in the RI Report and Risk Assessment. Lastly, DEQ's comments update, in a general sense, the current status of work completed at the NW Natural Property based on supporting documents submitted after the RI Report where appropriate.

RI REPORT

General Comments

Remedial Investigation Status. DEQ finds site investigations conducted to date in the uplands and offshore areas of the Gasco MGP by NW Natural, and in the northern portion of the Siltronic Property by NW Natural and Siltronic have determined that:

- The general geology of the area of investigation consists of highly variable fill material overlying alluvium consisting of an upper fine-grained silt unit; underlain by mixtures of silty sand, fine sand, and medium sand, intermixed with silt and sandy silt; grading downward into predominantly medium sand with silt and sandy silt. A basal gravel occurs in the deepest portions of the alluvium. Basalt underlies the alluvium everywhere across the NW Natural and Siltronic properties.
- The fill unit is heavily contaminated by MGP waste throughout the former Gasco MGP production and waste management areas;

- Mobile DNAPL in the fill unit in the western portion of the NW Natural Property (i.e., under the former MGP process areas) is migrating northward and eastward with evidence of vertical migration into the alluvium;
- DNAPL occurring in the fill unit has penetrated through the upper silt unit of the alluvium into coarser-grained alluvial sediments beneath the former effluent storage, settling, and overflow ponds (former effluent ponds), and discharge areas on the NW Natural Property, and has migrated horizontally towards the river and vertically downward to depths of approximately 85 feet below ground surface (bgs);
- DNAPL occurring in fill and alluvium has the potential to migrate to the Willamette River in the southern portion of the NW Natural Property;
- DNAPL associated with a former effluent pond has migrated horizontally towards the river and vertically downward to depths of greater than 135 feet bgs in the northern portion of the Siltronic Property;
- Surface water occurs seasonally in ponds located in the northern and southern portions of the NW Natural Property, and as stormwater which is discharged via a single on-site outfall (stormwater is currently undergoing a source control evaluation consistent with JSCS guidelines);
- Groundwater beneath the NW Natural Property and northern portion of the Siltronic Property occurs in three principal water-bearing zones, including the fill water-bearing zone (WBZ), alluvial WBZ, and Columbia River Basalt (CRB);
- MGP waste and contamination have: 1) impacted surface water and sediments (or soil when dry) of seasonal pond areas; and 2) resulted in widespread groundwater impacts in the fill WBZ and contaminated the underlying alluvial WBZ to depths of between 100 feet and 150 feet bgs in the northern and southern portions of the NW Natural Property respectively;
- Groundwater in the fill WBZ and alluvial WBZ are complete contaminant transport pathways from the uplands to the Willamette River;
- Dissolved MGP constituents in the fill WBZ and alluvial WBZ have migrated from the uplands out to and under the Willamette River at concentrations that significantly exceed relevant screening criteria; and
- Historic direct discharge and deposition of MGP waste have resulted in extensive impacts to river sediments offshore of the NW Natural Property and the northern portion of the Siltronic Property.

DEQ concludes from the site characterization work completed by NW Natural that:

- The locality of the facility (LOF) currently:
  - Encompasses the NW Natural Property and the northern portion of the Siltronic Property;
  - Includes impacted sediments in the Willamette River offshore of the NW Natural Property and northern portion of the Siltronic Property; and
  - Extends vertically downward to include the fill WBZ and alluvial WBZ (see DEQ's comment to Section 8.4.3 regarding the status of the CRB).

  It should be noted, work being conducted by NW Natural on the Siltronic Property, and to be performed the northern portion of the NW Natural Property and offshore, will likely alter the boundaries of the LOF described here.

- Current and reasonably likely future beneficial use of groundwater within the LOF includes the following:
  - Recharge to the Willamette River (current beneficial use of groundwater in the fill WBZ and alluvial WBZ); and
  - Industrial use (reasonably likely future beneficial use of groundwater in the alluvial WBZ).
- Soil and groundwater impacted by MGP waste and/or its associated contamination, represent a significant potential risk of exposure to human health and ecological receptors in the uplands, including the riverbank.
- Groundwater in the fill WBZ and alluvial WBZ is contaminated by MGP constituents that could significantly and adversely affect the current beneficial uses of groundwater (river recharge), and there is potential risk of exposure to human health from groundwater in the alluvial WBZ under an industrial use scenario.
- Direct discharge and/or deposition of MGP waste into the Willamette River and its sediments represent a significant potential risk of exposure to benthic and aquatic organisms in the Willamette River and its sediments which is being addressed under EPA oversight.

Several years ago DEQ prioritized source control over the Gasco Site upland RI/FS. The goal of source control was to identify high priority contaminant transport pathways to the river, and design SCMs to control those pathways so in-water actions could proceed without the risk of recontamination. Completion of the uplands RI/FS of the Gasco Site was to follow source control. As such, SCMs evaluation, selection, planning, and design were prioritized over the RI and Risk Assessment.

The source control project involved significant data collection efforts along, near, and offshore of the NW Natural and Siltronic properties. Based on the investigative work completed to support source control and the results of the uplands RIs of both properties, DEQ determined the shoreline of the NW Natural Property and the northern portion of the Siltronic Property are high priorities for source control (i.e., removal action). The portion of the shoreline identified as the highest priority for source control (Segment 1) extends from near the south side of the Fuel and Marine Marketing (FAMM) leasehold on the NW Natural Property, to upstream of the former effluent pond overflow area (EPOA) on the Siltronic Property. This segment coincides with the heaviest impacts identified near the river, including riverbank soils, groundwater contaminated by MGP waste, and DNAPL. Segment 1 also includes the portion of the Siltronic Property where groundwater contamination caused by Siltronic has commingled with MGP-related DNAPL and groundwater contamination resulting from the former operations of the Gasco MGP. The segment of NW Natural's shoreline between the south side of the FAMM leasehold and NW Natural's downstream property line with US Moorings (Segment 2) is considered a high priority for source control primarily due to the presence and concentrations of MGP COI, particularly cyanide compounds, in riverbank soils and groundwater. A third shoreline segment (Segment 3) extends from upstream of the EPOA to the upstream Siltronic Property line. A source control evaluation of Segment 3 is ongoing.

Consistent with the terms of the MGP Agreement and Joint Order, NW Natural completed a Groundwater/DNAPL Focused Feasiblity Study[9] (FFS) for Segment 1 and Segment 2 in November 2007. The Groundwater/DNAPL FFS presents the remedial action objectives (RAOs) for source control, which were jointly developed by NW Natural and DEQ and include: 1) controlling, and containing uplands groundwater in the fill WBZ and alluvial WBZ contaminated by MGP constituents; and 2) preventing DNAPL in the uplands from migrating to the river. The Groundwater/DNAPL FFS evaluates source control measures (SCMs) alternatives and makes recommendation for a combination of SCMs to achieve RAOs, including a series of groundwater extraction wells in the alluvial WBZ along shoreline segments 1 and 2 , and a vertical barrier along the northern portion Segment 1 (i.e., the southern portion of the NW Natural Property). DEQ approved NW Natural's SCMs recommendation subject to conditions and comments detailed in a March 21, 2008 letter (March 21st Letter). Design of SCMs is ongoing.

Data Gaps. Based on DEQ's review of the RI Report and additional supporting documents referenced above, DEQ concludes there are data gaps in the NW Natural Property RI that warrant further investigation. Data gaps are primarily associated with the northern portion of the property along the U.S. Moorings property line; and fully characterizing MGP waste and exposure pathways for purposes of the human health and ecological risk assessments.

U.S. Moorings Site. The ACOE's site characterization work completed to date found evidence of MGP contamination on the U.S. Moorings site. Soil and groundwater sampling and analytical work detected MGP COI in the southern portion of the site similar to those associated with the "former northern spent oxide/gas purifier waste storage pile" (spent oxide pile). The spent oxide pile was formerly located immediately adjacent to, and along the property line between the NW Natural and ACOE properties. According to the RI Report, the spent oxide pile contained up to approximately 80,000 cubic yards of spent oxide material and wood waste. Between 1972 and 1975, this material was reportedly removed offsite and landfilled or used as fill onsite.

Work completed by NW Natural documents soil and groundwater contamination associated with the spent oxide pile in the uplands and offshore of the northern portion of the NW Natural Property. NW Natural should conduct additional soil and groundwater investigations in the northern portion of the NW Natural Property to: 1) delineate the nature and extent of MGP contamination in soil and groundwater; 2) evaluate the occurrence and direction(s) of groundwater flow in the fill WBZ and alluvial WBZ; and 3) characterize the concentrations of MGP COI in soil and in groundwater migrating from the NW Natural to offsite areas, including the U.S. Moorings site. DEQ expects the scope of these investigations to include drilling and installation of monitoring wells in the fill WBZ and alluvial WBZ. This work should also be scheduled to support any additional data collection needs of the Risk Assessment. Additionally, potential MGP soil and groundwater impacts in the southern portion of the U.S. Moorings site should be considered during planning, design, and implementation of the Segment 2 SCMs (e.g., including new monitoring wells in the network of Segment 2 SCMs performance monitoring wells).

[9] Anchor QEA, LLC, 2007, "Groundwater/DNAPL Source Control Focused Feasibity Study, NW Natural "Gasco Site," November,

Characterizating MGP Waste. The RI Report documents significant contamination of the NW Natural Property by MGP waste, including tar and oil (i.e., DNAPL). The MGP waste does not correspond to the generic products (i.e., gasoline, diesel, or mineral oil) listed in DEQ's RBDM Guidance[10]. Typically under these circumstances additional sampling and analytical work would be conducted during the RI to characterize the composition, distribution, and toxicity of total petroleum hydrocarbon (TPH) fractions, and develop site-specific risk-based concentrations (RBCs) for all applicable exposure pathways. To complete this type evaluation for the NW Natural Property, two data gaps would need to be filled, including;

- Characterizing TPH fractions in MGP waste (e.g., spent oxide, lampblack, tar, oil) collected from different portions of the site, including but not limited to the Koppers leasehold, former effluent ponds and discharge areas, and spent oxide pile areas; and
- Evaluating the nature and extent of MGP waste contamination site-wide, which would involve collecting and analyzing representative samples of environmental media for TPH factions of MGP waste across the NW Natural Property.

The process of filling the MGP waste data gap represents a substantial commitment of additional time and resources. Given the status of the uplands RI and Risk Assessment, SCMs design, and in-water sediment project, DEQ's comments to the ERA and HHRA recommend alternatives that rely on existing MGP waste constituent data and focus additional data collection work on characterizing TPH fractions where needed to support the Risk Assessment.

DNAPL Migration and Mobility in the Fill Unit. As summarized above, previous work on the NW Natural Property and in the northern portion of the Siltronic Property, shows the former effluent ponds and discharge areas are sources of mobile DNAPL to the fill WBZ and alluvial WBZ; documents DNAPL has migrated away from former effluent ponds towards the river and vertically downward; and is a significant source of contamination to groundwater in the fill WBZ and alluvial WBZ. Removing this DNAPL to the extent necessary to control and contain its potential movement during operation of the hydraulic control/containment system was identified as an additional objective of RAO #1. Based on modeling work completed by NW Natural, DEQ allowed DNAPL removal to be sequenced after construction of the vertical barrier and hydraulic control and containment SCMs. Currently, DEQ understands NW Natural acknowledges DNAPL under the former effluent ponds and discharge areas warrants remedial action(s) and is committed to evaluating DNAPL remedial action alternatives in the uplands FS.

In addition to DNAPL under the former effluent ponds and discharge areas, NW Natural documents a large body of DNAPL in the fill unit beneath the Koppers, Inc. (Koppers) leasehold and NW Natural's Liquid Natural Gas (LNG) plant. Regarding the vertical migration of this DNAPL, NW Natural indicates the upper silt unit acts "…as an effective barrier to vertical movement beneath the former process areas…" In support of this conclusion, NW Natural notes DNAPL and significant concentrations of dissolved phase MGP constituents have not been observed below or downgradient (east) of former process areas. NW Natural further indicates the DNAPL body occupies a linear trough in the top of the silt unit that may correspond to a former stream channel aligned north-south

[10] http://www.deq.state.or.us/lq/rbdm.htm

across the site. The outlet of the former channel was located within the southern portion of the US Moorings property. NW Natural indicates the orientation of the former channel may act to prevent migration of DNAPL towards the river.

DEQ disagrees with these interpretations, finding evidence DNAPL under the former process areas has migrated below the fill unit and contaminated the alluvial WBZ, and is mobile and migrating towards the river. The information supporting DEQ's conclusions is summarized below.

Vertical Migration of DNAPL and Groundwater Through the Silt Unit. Based on review of the RI Report, DEQ finds evidence of vertical migration of DNAPL and groundwater contamination through the silt unit beneath the Koppers leasehold. During drilling at Boring M-15, a boring located near monitoring well MW-15-50; "brown product blebs" were observed in fine sand at a depth of 44 feet bgs after approximately 25 feet of the upper silt unit were penetrated. The lack of NAPL in the borehole above the sand and persistent detections MGP COI[11] in this monitoring well since it was installed indicate the cause of contamination is not drilling related (i.e., not caused by drag-down). Furthermore, the fine sand mentioned in the paragraph above, was observed to be over 10 feet thick at the MW-15 monitoring well cluster. As such, DEQ questions NW Natural's inclusion of the fine sand in the silt unit. It appears the material is more representative of the upper alluvium. As such, future discussions of, and figures showing groundwater contamination in the alluvial WBZ should include data from monitoring MW-15-50.

The information summarized above indicates DNAPL and impacted groundwater are moving through the silt unit into the alluvium and contributing to contamination of the upper alluvial WBZ. Based on this information and determinations regarding current and reasonably likely future use of groundwater beneath the NW Natural Property (see DEQ's comment to Section 8.4.3), DEQ expects NW Natural to carry DNAPL and contaminated groundwater beneath the former process area(s) forward into removal action planning and/or the uplands FS.

DNAPL Mobility and Lateral Movement in the Fill Unit. Regarding the mobility and lateral movement of DNAPL under the process areas, DEQ finds evidence in work conducted in the vicinity of the MW-13 monitoring well cluster[12] that DNAPL is mobile and moving to the north and north-northeast. NW Natural conducted work at the MW-13 monitoring well cluster in January 2007 to evaluate the appearance of DNAPL in MW-13-61. The scope of the investigation included advancing numerous push-probe borings through the fill unit and upper silt unit into the alluvium. Based on the work completed, NW Natural concluded the presence of DNAPL in the well resulted from a failed well seal, and a replacement monitoring well was constructed with DEQ's approval (i.e., MW-13-61R).

The MW-13 cluster is located over 100 feet east from monitoring well MW-06-32, a well with historic presence of DNAPL. When the two MW-13 wells (i.e., MW-13-30, MW-13-61) were

[11] For example, average naphthalene and benzene concentrations based on more than 20 samples are greater than approximately 7,000 micrograms per liter (ug/L, or parts per billion) and 40,000 ug/L, respectively.
[12] Hahn and Associates, Inc., 2007 "Push Probe Investigation Results, Monitoring Well MW-13-61 Area, Northwest Natural Gas Company Site, Portland, Oregon - ECSI No. 83," April 4, a report prepared for NW Natural.

originally drilled and installed in December 1997, DNAPL was not observed. During the course of the January 2007 investigation, push-probe drilling confirmed the presence of DNAPL at the base of the fill unit at the MW-13 cluster and identified a previously unknown "lobe" of DNAPL extending north-northeast off the main body of DNAPL underlying the former process areas. This information indicated DNAPL migrated into the vicinity of the MW-13 cluster after the wells were installed.

Based on the results of the investigation, DEQ concurred with NW Natural that the configuration of the top of the upper silt unit surface influences the distribution of DNAPL in the fill unit. In addition DEQ concluded DNAPL in the vicinity of the MW-13 cluster is mobile and migrating. Given the overall slope of the upper silt unit in this portion of the site is to the north, and the orientation of the lobe of DNAPL is to the north-northeast, DEQ further concludes DNAPL is currently migrating with components of flow to the north and east.

The DNAPL body under the former process areas represents a large mass of material with significant migration potential. The work completed at the MW-13 cluster shows that even where the occurrence of DNAPL is observed, multiple borings are needed within a small area to assess its distribution. Although DEQ acknowledges the upper silt unit provides some protection to the alluvial WBZ, based on the information summarized here the lateral continuity, configuration, and thickness of the silt unit and its influence on DNAPL movement remains uncertain.

Evidence of lateral DNAPL migration and the difficulty in delineating its distribution, provides further justification for DNAPL and contaminated groundwater beneath the former process area(s) to be carried forward into removal action planning and/or the upland FS.

Specific Comments

Section 2.1, page 11. Figure 5 shows the alignments of subsurface utilities and piping at the NW Natural Property. Additional information should be provided to document the size, depth, and construction materials for buried features (e.g., as-builts for each type of piping). Of particular interest is the relationship of the underground utilities and piping to the water table, and whether piping alignments represent potential preferred pathways for contaminant migration.

Section 2.3, page 13. For clarification, the principal Pacific Gas and Coke Company MGP waste management areas on the Siltronic Property were the effluent overflow pond(s) and spent oxide pile. Both features were located along the boundary between the NW Natural and Siltronic properties. However, waste management also occurred in the north central portion of the Siltronic Property (i.e., "excavation/depression"). This excavation/depression is located under the southern end of Siltronic's Fab 1 Building.

Section 2.5, page 27. The nested table of COI should be revised to include TPH, 1,2,4-trimethylbenzene (1,2,4-TMB), and 1,3,5-trimethylbenzene (1,3,5-TMB). DEQ's general comments provide the reason for adding TPH. Based on DEQ's review of the EMRs and PW-01

time-series sampling data[13]; 1,2,4- TMB and 1,3,5-TMB should be added because the detected concentrations of these two chemicals exceed EPA tap-water screening levels and DEQ occupational RBCs in groundwater. Groundwater screening criteria for these chemicals are exceeded in the fill and alluvial water-bearing zones on both the NW Natural and Siltronic properties.

Section 2.6, page 27. As indicated above, DEQ is expecting the Risk Assessment to be revised and resubmitted. As such, the list of human health and ecological chemicals of potential concern (COPCs) for uplands exposures provided in this section of the RI Report are considered preliminary and subject to change.

Section 3.4.2, page 51. DEQ has numerous comments regarding air sampling completed at the NW Natural Property, including data collection, analysis, and use. All of the comments are included in the Risk Assessment portion of this letter (see DEQ's general comments to the HHRA).

Section 4.2, page 58. In addition to DNAPL recovery at MW-6-32, DEQ notes that since August 2007, NW Natural has been recovering DNAPL at monitoring well MW-13-30. Recently DEQ approved upgrading the recovery system at MW-13-30 to continuous operation using a solar powered air compressor system.

Section 4.4, page 60. NW Natural indicates stormwater and groundwater in the fill WBZ collects in the LNG containment basin and provides summary information for 2005. This water is routed through two granulated activated carbon units prior to being discharge to the City of Portland publicly-owned treatment works (POTW) under permit. NW Natural should provide the historic records of the volumes of combined stormwater and groundwater removed from the basin for DEQ's information and completeness. This information should be considered and incorporated into planning and design of SCMs involving the fill WBZ.

Section 6.1.2, page 66. NW Natural indicates at the base of the fill unit a fine-grained silt unit is encountered and, "…the silt surface is considered to express the ground surface of the site prior to site development and filling activities." In general DEQ agrees with this interpretation, but considers it important to acknowledge historic MGP operations potentially modified the upper surface of the silt unit. For example, Section 2.3.2.1 indicates clean-out of former effluent ponds using drag-lines was periodically conducted to maintain capacity. This practice reasonably involved excavation into the silt unit resulting in decreased thickness in these areas (i.e., creation of a depression). Low points in the top of the silt are areas where MGP DNAPL could migrate and accumulate.

Evidence of this scenario occurs on the Siltronic Property at monitoring well cluster WS-15. The WS-15 cluster is installed below the silt unit and within: 1) the footprint of a former effluent pond; and 2) a depression in the silt unit where the silt is interpreted to be less than 3-feet thick. Accumulation of DNAPL in WS-15-85 exceeds 10-feet. Accumulations of DNAPL represent

[13] Hahn and Associates, Inc., 2006, "Aquifer Test Chemical Data Summary and Evaluation - NW Natural, Gasco Site, Portland, Oregon," January 16, a technical memorandum prepared for NW Natural.

source areas of deeper contamination to the alluvial WBZ and are important to planning removal and/or remedial actions.

Regarding NW Natural's interpretations of the configuration of the top of the silt unit at WS-15, DEQ notes the low point between this monitoring well cluster and the river is not 9-12 feet mean sea level (MSL) as implied in the text, but 2.5-3 feet MSL as shown in Figure 14.

Section 6.1.2, page 67. DEQ would note that subsequent to submittal of the RI Report, site investigations completed by NW Natural near the shoreline and offshore evaluated the alluvium to depths of over 200 feet bgs. Observations made during drilling indicate an overall coarsening downward sequence to the basalt, with mixtures of silt, sandy silt, silty sand, and fine to medium sand, giving way to predominantly medium sand below approximately 100 feet bgs within approximately 200 feet of the shoreline. Depending on location, a basal gravel of varying thickness separates sandy alluvium from basalt.

Section 6.1.3, page 68. DEQ notes that subsequent to submittal of the RI Report, site investigations completed by NW Natural near the shoreline and offshore provided additional information regarding the configuration of the basalt surface below the NW Natural Property. This work further indicates the top of the basalt forms a basin-like structure beneath the site. The basin opens to the east, and is greater than 220 feet deep near the shoreline at monitoring well clusters MW-18 and MW-19.

Section 6.2.1.1. See DEQ's General Comment regarding DNAPL in the western portion of the NW Natural Property.

Section 6.2.1.2, page 70 (Surficial Fill WBZ). NW Natural indicates the saturated thickness of the fill WBZ ranges between 1 and 5 feet at locations near the river. However, comparison of groundwater elevations in the fill WBZ to the bottom elevation of the fill unit suggest the saturated thickness adjacent to river more typically ranges from 5 to 15 feet. Given the volumetric discharge from the fill WBZ is proportional to the saturated thickness and varies seasonally, this information should be further evaluated to support planning of SCMs for the fill WBZ.

Section 6.2.1.2, page 71 (Flow Direction). Section 4.4 of the RI Report indicates the base of the LNG tank basin is at an elevation of approximately 18 feet MSL, which is "…typically 2 to 7 feet below the adjacent water table…" As required by the Public Utility Commission, NW Natural dewaters the basin for health and safety reasons. However, the influence of dewatering on water levels in the fill WBZ is not reflected in the equipotential contour maps provided in the RI Report. Contour maps show a linearly declining gradient across, and groundwater elevations many feet above the bottom of the basin. For example, Figure 18 shows the elevation of the water table as ranging from approximately 19 to 23 feet MSL across the basin (i.e., 1 to 5 feet higher than the bottom). This comment also applies to Figure 21. Water table contour maps for the fill WBZ should be revised to reflect the effect of dewatering the LNG tank basin. In addition, if other features are present on the NW Natural Property that could locally influence the configuration of

the water table surface (e.g., sumps under the Koppers leasehold) they should be identified and incorporated into water table contour maps.

Section 6.2.1.2, page 71 (Horizontal and Vertical Gradients). DEQ concurs with NW Natural conclusions that: 1) a downward vertical hydraulic gradient exists between the fill WBZ and the alluvial WBZ; and 2) where the silt unit is thin, absent, or penetrated by secondary porosity (e.g., root and/or rootlet voids) groundwater in the fill WBZ would tend to migrate vertically downward. Based on data collected on the NW Natural and Siltronic properties, vertical migration through the silt unit by DNAPL and contaminated groundwater has been observed and documented. DEQ would add where the silt unit is present, the vertical gradients are large (i.e., groundwater levels in the fill WBZ are feet above those in the upper alluvial WBZ). In addition, although vertical migration through the silt has been documented, DEQ interprets overall groundwater flux through the fill WBZ to be laterally directed towards the river. The timing and magnitude of maximum groundwater flux through the fill WBZ represents an information need for SCMs planning and design.

Section 6.2.1.2, page 72 (Hydraulic Conductivity). The RI Report indicates NW Natural conducted three variable head tests in the fill WBZ on the NW Natural Property. DEQ concludes this dataset is not adequate for purposes of developing representative ranges of hydraulic conductivities for different fill WBZ material types across the NW Natural Property. The data collected to date also does not support planning of SCMs intended to control and contain groundwater migrating to the river in the fill WBZ. NW Natural should be advised that unless alternate sources of information are available for estimating groundwater flux, additional hydraulic conductivity testing should be conducted during fill WBZ SCMs planning and design.

Section 6.2.1.3. As discussed in DEQ's comment to Section 6.1.2, work completed after the RI Report was prepared provides data to subdivide the alluvium into upper and lower units based on grain-size. Contrasts in the hydraulic conductivities between the upper and lower alluvium allow the alluvial WBZ to be subdivided in a consistent manner (i.e., upper and lower alluvial WBZs). Based on the results of aquifer testing documented in the RI Report, and aquifer testing and groundwater modeling included in the Groundwater/DNAPL FFS, the horizontal hydraulic conductivity of the lower alluvial WBZ (approximately 300 feet/day) is at least 20 times greater than the upper (approximately 10 to 15 feet/day).

Section 6.2.1.4. It should be noted that during decommissioning of cathodic protection boreholes water-bearing zones in the basalt were identified at approximately 80 feet bgs, and by downhole video surveys between 106 and 145 feet bgs. These zones project horizontally into the alluvial WBZ, and although not mentioned in the RI Report, provide evidence the basalt represents a source of recharge to the alluvial WBZ.

Section 6.2.2, page 77. Regarding the distribution of MGP COI between the uplands groundwater and the Willamette River, DEQ notes that work documented in the Offshore Investigation Report included field tasks designed to assess the movement of contaminated groundwater in the alluvial WBZ from the uplands out to and under the river. The scope of work also included installing

seepage meters to further assess the interactions between uplands groundwater and surface water. The findings of the completed work indicate that, depending on the COI, contaminated groundwater in the alluvial WBZ migrates from the uplands greater than 300 feet out to and under the river. Furthermore, seepage meters installed in the river indicate that overall, groundwater discharges into the river offshore from the NW Natural Property. Contaminated groundwater discharges into the river through sediment that in places is heavily impacted from historic direct discharges and deposition of MGP waste from the former Gasco MGP. As such, the contaminant mass in sediment associated with direct discharged/deposited MGP waste, likely overwhelms groundwater concentrations beneath the river.

Section 6.3.2, page 79. DEQ notes that since the RI Report was submitted, NW Natural has undertaken an evaluation of the site stormwater conveyance systems as a potential source of contamination to the Willamette River. Catch basin sediment sampling has been completed and stormwater sampling will be conducted this precipitation season.

In addition, Koppers applied for and received a permit (#400-200) from the City of Portland to discharge stormwater to the POTW collected by conveyance systems (designated A1 and A2) in the process areas. As such, with the exception of two catch basins (i.e., SS-A3 and SS-A4) and associated piping located in the gate entry area; stormwater is not being discharged to Doane Creek from the Koppers leasehold. DEQ has informed NW Natural the status and locations of catch basins SS-A3 and SS-A4 should be confirmed. In the event the catch basins are located, NW Natural has committed to completing sediment and stormwater sampling per JSCS guidelines.

Section 7.2.1, page 88. DEQ acknowledges NW Natural's efforts to develop a system for identifying and describing MGP waste and/or associated contamination observed in the field during subsurface investigations. However, DEQ considers visual observations to be generally unreliable for interpreting the nature, distribution, and properties MGP DNAPL in the field. For example, at numerous locations, observations during drilling indicated the presence of sheen or strong odor in the formation, but subsequent to constructing a monitoring well DNAPL entered the installation. For this reason DEQ expects future work on the NW Natural and Siltronic properties to utilize Targost® logging equipment to delineate the nature and extent of DNAPL. The Targost® equipment has proven itself effective at identifying MGP DNAPL beneath the NW Natural and Siltronic properties.

Section 7.2.2, page 90. DEQ notes the lateral distribution of DNAPL in the alluvial WBZ shown on Figure 25 occupies an area of approximately 4 acres. Based on the results Targost® work completed on the NW Natural and Siltronic properties, the area has been expanded towards the river and to the southeast. As a result, in plan-view the lateral extent of DNAPL in the alluvial WBZ shallower than 100 feet bgs is now interpreted to be over approximately10 acres.

DEQ agrees with NW Natural's comment that DNAPL which would not otherwise migrate, can migrate into a monitoring well subsequent to completion. However, continued accumulation in a well over time is an indication DNAPL is mobile and movement is occurring. Although not

mentioned in the RI Report, this is the case at many of the monitoring wells on the NW Natural Property (e.g., MW-6-32, MW-13-30).

Section 7.2.3.1, page 92 (Viscosity). NW Natural indicates the relative viscosity of DNAPL encountered at different locations can be inferred from the time it takes for the DNAPL to enter the borehole or monitoring well. Alternatively, appearance of DNAPL may reflect the degree of saturation and/or time needed for saturated flowpaths to be re-established after being disrupted by the drilling process. Laboratory testing remains the most reliable means of evaluating the physical and chemical properties of DNAPL on the Gasco Site.

Section 7.2.4.1, page 97. DEQ's General Comments regarding the upper silt unit and nature, distribution, and mobility of DNAPL apply to this section of the RI Report.

Section 7.2.4.2, page 99. As mentioned in DEQ's General Comments, work completed during the RI and data collected by Targost® logging determined the former effluent ponds are source areas of mobile DNAPL, and DNAPL has accumulated on and penetrated through the fill unit into the alluvium. DEQ interprets the data to indicate DNAPL has accumulated beneath former effluent ponds. Depending on location, DNAPL occurs nearly continuously over vertical depth intervals of many feet (e.g., TG-8, TG-3S). Furthermore the data indicate mobile DNAPL is migrating away from the ponds (horizontally and vertically). The depth of DNAPL observed during drilling, in monitoring wells, and identified by Targost® logging is approximately 85 feet bgs on the NW Natural Property and 135 feet bgs on the Siltronic Property. Consistent with agreements reached with DEQ, NW Natural will include a preliminary evaluation of DNAPL removal approaches for the former effluent ponds and a timeframe for conducting the work in the SCMs Interim Design Report. DEQ also expects the uplands site-wide FS to evaluate remedial action alternatives that address DNAPL under the former effluent ponds and discharge areas, and former process areas.

Section 7.3 and 7.4. These two sections of the RI Report discuss the nature and extent of soil and groundwater contamination in terms of MGP COI sampling and analytical data collected at the NW Natural Property. Soil and groundwater data are compared to human health and ecological screening criteria for this purpose. DEQ's comments to the Risk Assessment speak to the adequacy, use, and analysis of sampling and analytical data for purposes of evaluating the risk of exposure to human health and ecological receptors from MGP waste and associated contamination at the NW Natural Property.

For clarification, regarding cyanide discussions presented in Section 7.4.2.3, DEQ generally concurs with NW Natural regarding free cyanide bioavailability and toxicity; however DEQ does not consider free cyanide data alone to be adequate for assessing potential exposure to human health and/or ecological receptors. As part of planning and designing the treatment system for the groundwater SCMs, DEQ requested NW Natural to expand the suite of cyanide analyses to include "available" and "weak-acid dissociable" forms. Cyanide in these forms has the potential to convert to free cyanide in the river environment. The evaluation of potentially convertible forms of cyanide is ongoing. The results of the evaluation will provide the basis for: 1) further assessing the nature and extent of cyanide in uplands groundwater (including treated groundwater) and surface water;

and 2) selecting cyanide analytical methods for future water sample testing. As such, DEQ considers NW Natural's interpretations regarding the distribution of free cyanide in groundwater to be preliminary and subject to change pending the outcome of the cyanide evaluation, and updated COI screening analysis discussed further in our comments to the ERA and HHRA.

Section 7.6, page 142. DEQ's concerns regarding the adequacy of air sampling, sample analysis, and potential risk of exposure to human health and ecological receptors via air pathway(s) are included in our comments to the Risk Assessment.

Section 8.1, page 147. As noted by DEQ under General Comments, RI work conducted by the ACOE documented contamination in the southern portion of the US Moorings site consistent with impacts in the northern section of the NW Natural Property resulting from the former Gasco MGP (e.g., northern spent oxide pile). In addition, the findings of the Offshore Investigation Report document sediment, transition zone water, and groundwater contamination associated with the former Gasco MGP offshore of the NW Natural and Siltronic properties. Future discussions of the NW Natural Property should acknowledge the potential for the Locality of Facility (LOF) to encompass the southern portion of the US Mooring site and extend offshore of the NW Natural Property and the northern portion of the Siltronic site.

Section 8.2, page 148. DEQ accepts the Landuse Determination (LUD) for the NW Natural Property presented here. NW Natural should be advised the LUD for the property will be subject to future scheduled reviews as part of the Record of Decision (ROD) for the Gasco Site uplands.

Section 8.3.1, page 149. As indicated by NW Natural, with the exception of seasonal ponds in the southern (former tar ponds area) and northern (spent oxide pile area) portions of the NW Natural Property, no current and/or reasonably likely future uses of on-site surface water have been identified at the NW Natural Property. In the RI Report the seasonal ponds are described as "possible migratory or transitory ecological habitat." The ERA includes evaluation of seasonal ponds per previous agreements reached between NW Natural and DEQ.

Due to the industrial nature of the property and plans to redevelop portions of the site where the ponds occur, the seasonal ponds to date have been considered impermanent features. However, the seasonal ponds have been present in their current configuration for over 25 years and redevelopment plans have yet to be realized. NW Natural should be advised as long as the ponds exist they represent seasonal habitat for aquatic biota (i.e., invertebrates), provide transitory habitat for migratory birds, and enhance habitat for other terrestrial receptors during the precipitation season.

Section 8.4.3, page 155. Previously DEQ determined industrial use of the CRB to be a reasonably likely use of groundwater beneath the NW Natural Property. Based on NW Natural's acceptance institutional controls on use of the CRB, including periodic usage reviews, DEQ did not require installation of a monitoring well and groundwater monitoring of the basalt. Work completed subsequent to the NW Natural and DEQ agreement regarding the CRB, indicates the alluvial WBZ represents an alternative source of groundwater for industrial use within the LOF. Pilot extraction

well tests conducted in July 2007 at PW-3-85 and PW-3-118 (then designated PW-4-85 and PW-4-118) found the alluvial WBZ is capable of yielding up to 90 gpm. This information indicates the alluvial WBZ can meet industrial needs.

Based on the information summarized above, the Beneficial Water Use Determination (BWUD) for the NW Natural Property should be revised to reflect the findings of pilot extraction tests. Furthermore, DEQ finds:

- Industrial use of the alluvial WBZ to be a reasonably likely future use of groundwater beneath the NW Natural and Siltronic properties; and
- There is potential risk of exposure to human health from groundwater in the alluvial WBZ under an industrial use scenario.

NW Natural should be advised the ROD will require the BWUD to be reviewed according to a schedule similar to the LUD.

Section 9, page 158. Comments regarding this section of the RI Report are incorporated into DEQ's comments to the Risk Assessment.

RISK ASSESSMENT

DEQ's comments to the Risk Assessment are organized into two sections corresponding to Section 2 (Ecological Risk Assessment) and Section 3 (Human Health Risk Assessment) of the Risk Assessment. NW Natural should be advised that many of DEQ's comments apply to both the ERA and HHRA. Rather than attempt to identify which apply to both, DEQ's comments are provided separately for each section. NW Natural should review this letter closely to ensure comments for the ERA and HHRA are fully addressed.

General Comments - Section 2, Ecological Risk Assessment

Cyanide Evaluation. Apparently, cyanide is not screened for soils because DEQ does not have a screening level values (SLV) for soils[14]. However, toxicity reference values (TRVs) are available (Sample et al., 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*) and should be used to assess risk to terrestrial receptors by cyanide concentrations in soil. In addition to soils, the potential for cyanide to be present in, and/or convert to more toxic forms (e.g., free cyanide [CN^- and HCN] in site wetland ponds and tank containment basins (e.g., the LNG tank basin) exists, and can lead to exposure of the more toxic forms of cyanide to aquatic biota (i.e., invertebrates), and birds and mammals. Mammalian and bird drinking water, and soil cyanide "No Observed Adverse Effect Levels" (NOAELs) and "Lowest Observed Adverse Effect Levels" (LOAELs) should be derived and compared to site concentrations using methods DEQ describes in our general comment regarding "Soil Exposure Uncertainties" below.

[14] http://www.deq.state.or.us/lq/cu/ecorisks.htm

Evaluating the Wetland Pond(s) Area. DEQ disagrees with NW Natural regarding whether exposure of aquatic and/or terrestrial receptors to sediment, water or biota in on-site pond areas should be evaluated in the ERA. The on-site pond areas should be considered and evaluated as aquatic and wetland habitat as these features are wet the majority of the year. Most of the ecological habitat, including the largest wetland ponds, is located in the southeastern portion of the NW Natural Property (i.e., the former effluent tar ponds areas). The risk assessment for the wetland ponds should ultimately assess the risk associated with heavily contaminated surface and subsurface soil that in some areas is also seasonally covered by surface water in the form of upland ponds. Characterization of these ponds and underlying soil concentrations is currently limited. However, based on the available data, detections of COI in surface water exceed DEQ SLVs. Additionally, given the area is adjacent to the Willamette River, it is likely well used by resident receptors as well as migratory species. A more complete surface water dataset and more thorough characterization of resident aquatic species are needed to support the ERA. This would involve collecting additional pond area sediment and surface water samples to better characterize exposure to terrestrial and aquatic receptors during different times of year to represent a range of conditions. Absent additional characterization work, DEQ must conclude from available soil and surface water data, the pond areas pose an unacceptable risk to ecological receptors.

Evaluating the Tank Basins. The RI Report documents groundwater discharge into the LNG basin as surface water. Accumulation of water in industrial areas of the NW Natural Property can be attractive to wildlife given the proximity of the site to the Willamette River and the river being a migratory bird corridor. As such, the LNG tank basins could sustain standing water that can be utilized by wildlife receptors, particularly migrating birds. DEQ acknowledges NW Natural's efforts to reduce ponding in the LNG basin by improving drainage, however, DEQ is concerned migrating birds could undergo significant short-term direct exposure to MGP constituents in groundwater discharging into the basin. To address this potential exposure scenario, data from monitoring wells MW-06-32, MW-10-25, MW-11-32, and MW-13-30 should be screened against appropriate acute exposure values applicable to representative large and small migratory waterfowl. The evaluation should include cyanide compounds. A summary of drinking water cyanide TRVs are available in Table 15.5 (birds) in Dzomback et al., 2006, *Cyanide in Water and Soil*. DEQ further understands stormwater is discharged into the FAMM tank basin. Based on this information, a similar evaluation of stormwater ponding should be conducted for the FAMM tank basin.

Soil Exposure Uncertainties. DEQ concludes from reviewing the ERA, there are considerable uncertainties associated with the existing soil and/or sediment sampling dataset related to depths of sampling, inconsistent analysis of COIs, and use of the data in estimates of exposure point concentrations (EPCs). Regarding sample depths, most of the samples from portions of the NW Natural Property designated habitat are limited to the shallowest surface soil (i.e., samples collected from 0.2 feet bgs). Relatively few soil samples are available from deeper intervals (e.g., 0 to 3.5 feet bgs). Pond sediment samples were apparently all taken at 0.2 feet bgs. In addition, it does not appear a consistent approach was used to analyze COI in soil and/or sediment samples. In several areas select metals analyses were performed, but not PAHs. In other locations, PAHs were analyzed for and not metals. Additionally, soil samples were not consistently analyzed for all COI

within a parameter group. For example, zinc data is very limited for the area of the former effluent ponds. Lastly, EPCs were calculated as site-wide values instead of for each habitat exposure area.

Given the uncertainties summarized above, DEQ identified numerous data gaps for the ERA in the assessment of soil exposure, including the following:

- Soil data available for the ERA is limited and comprised mostly of very shallow soil data (i.e., 0 to 0.2 feet). As a consequence, the risk analysis based on this soil profile underestimates risk to burrowing mammals.
- Risk estimates presented in the ERA are based on a 90% upper confidence limit (UCL) around the mean of all the site data, and are not broken down by ecological exposure units. DEQ concurs with NW Natural's identification of habitat at the site as shown by Figure 2-1, however NW natural should have calculated separate EPCs for each habitat area.
- The risk assessment uses TRVs that are based on a selected group of individual PAHs for which DEQ SLVs or surrogates are available. The resulting ERA concludes there is risk associated with only a few individual compounds. NW Natural's approach ignores the potential risk of exposure to ecological receptors by MGP waste, including tar and oil, which is present in many areas, notably in the southern portion of the site where the largest area of habitat occurs.

Meetings geared toward scoping the FS facilitated conversations between NW Natural and DEQ on ways data gaps identified in the ERA could be addressed for incorporation into the FS. During the meetings DEQ informed NW Natural that filling these data gaps would involve collecting additional soil data in habitat areas to more completely characterize the soil profile used by burrowing animals (i.e., down to 3 feet bgs). Alternatively, DEQ indicated the data gaps could be addressed using existing data as follows:

- Incorporating deeper existing soil sample data (i.e., data collected from 3 feet bgs or deeper) upward and into the depth interval from 0 to 3 feet bgs in order to better represent concentrations over the burrowing animals exposure profile. This should include samples to at least 6 feet bgs, although additional samples are available down to between 8 and 11.5 feet bgs if needed to supplement the dataset.
- Including the deeper soil data described above into calculations of 90% UCL concentrations for the 0 to 3 feet bgs depth interval for each of the habitat exposure areas.
- Using sediment samples collected in the ponds area (e.g., SD-1, SD-2, and SD-3) to characterize soil exposure. Total concentrations of high-molecular weight (HPAHs) range from 1,841 to 10,557 milligrams per kilogram (mg/kg, or parts per million) in these samples. The samples were taken from 0 to 0.5 feet bgs and are not included in soil EPC calculations.
- Defining the area of unacceptable risk to total low-molecular weight PAHs (LPAHs), HPAHs, and tar and oil in the 0 to 3 feet exposure unit by mapping the distribution of deeper tar and oil using historical photographs.

Using the recommendations above, DEQ examined the Tar Pond data relative to EPA's Ecological Soil Screening Level Values[15] (Eco-SSLs) and evaluated the risk of exposure by invertebrate and

[15] EPA, 2007, "Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons - Interim Final (OSWER 9285.7-78)," June, a guidance document prepared by the EPA's Office of Solid Waste and Emergency Response.

mammalian receptors to total LPAHs and total HPAHs. The Eco-SSLs provide benchmarks for LPAHs and HPAHs for soil invertebrates and mammals. When revising the Risk Assessment, NW Natural should use the Eco-SSLs values to screen soil data where MGP waste is present, followed by soil SLVs.

Consistent with the Eco-SSL guidance, DEQ examined data for the Tar Pond exposure area by multiplying NOAELs by 5 to estimate LOAELs for the total LPAHs and total HPAHs TRVs. Invertebrate soil NOAELs were not used to estimate LOAELs using this approach due to how they were derived. The results of DEQ's examination are presented in the attached Table 1. Comparing the estimated LOAELs with DEQ values used to estimate population level effects shows the SLVs are exceeded in most samples with only a few exceptions. Hazard quotients for LPAHs and HPAHs in soil range from 0.1 to 943 in depths to 6 feet bgs, and up to 1,694 in samples down to 11.5 feet. The evaluation presented in Table 1 supports DEQ's conclusion the ERA significantly underestimates risk to ecological receptors in the Tar Pond exposure area by restricting risk analysis to soil samples collected from 0 to 0.2 feet bgs, and not including TRVs that evaluate the cumulative effect of PAHs (e.g., EPA Eco-SSLs for total LPAHs and total HPAHs). The table also shows the vertical extent of risk exceedances. With few exceptions, samples exceed a hazard quotient of 1, and most represent hot spot levels (i.e., HQ$\geq$10).

DEQ also conducted a preliminary examination of the riverbank data using a subset of the samples and Eco-SSLs, but the small number of samples having been collected from 0 to 0.2 feet bgs limits the data evaluation. However, the limited sampling did detect HPAHs in three riverbank samples (i.e., SS-2, SS-3, SS-4) at concentrations resulting in an HQ greater than 1. Furthermore, one of the samples (i.e., SS-3) exceeded hot spot levels (HQ = 14.7). For purposes of revising the ERA, in the absence of additional data collection along the river bank within the 0 to 3 feet bgs exposure unit, NW Natural should assume soil within this interval exhibits significantly higher concentrations and would exceed hot spot levels. In addition to Eco-SSLs, riverbank samples should be screened according to the JSCS to evaluate risk to aquatic receptors.

NW Natural should be advised the Spent Oxide area, also an area of habitat at the NW Natural Property, has not been screened by DEQ as shown in Table 1 for the Tar Pond exposure area. However, when revising the ERA, NW Natural should examine the data from the Spent Oxide area for LPAHs and HPAHs following the same process as described above.

Risk of Exposure to MGP Waste. As mentioned in DEQ's general comments to the RI Report, MGP waste does not correspond to any generic petroleum hydrocarbon products and has not been characterized according to the RBDM Guidance. The inclusion of Eco-SSLs for total HPAH and total LPAH concentrations and effects values in the revised ERA will give some indication of the fraction of MGP waste posing the most risk to ecological receptors. However, direct contact with MGP waste, especially tar and oil, represents a physical threat to ecological receptors beyond what is represented by chemical exposure to HPAHs and LPAHs. DEQ considers the presence of MGP waste, especially tar and/or oil in habitat areas, as being indicative of unacceptable risk for this reason.

In the revised ERA, NW Natural should graphically show the extent of MGP waste occurring between 0 to 3.5 feet bgs to indicate where the threat of direct contact to ecological receptors could be present. Except for the Tar Pond area, the presence of tar and oil within the boundaries of MGP waste shown in the figure should be carried forward into the uplands FS as potential hot spots. During the initial scoping of a removal action in 2003, NW Natural previously identified a preliminary soil hot spot area for the Tar Pond area[16]. This area should be used as the starting point for identifying a potential ecological hot spot for soil in the Tar Pond area. Note, NW Natural uses a multiplier of 500 to estimate ecological soil hot spot concentrations in the removal action scoping document. For clarification, when calculating ecological hot spots DEQ screening benchmark values should be multiplied by 50.

Specific Comments - Section 2, Ecological Risk Assessment

Section 1.2.2 (Page 13). On-site surface water is listed as on-site ponds and ditches located in the former tar pond and spent oxide areas, and the LNG containment basin. NW Natural should review and update or add figures to show the locations and alignments of features currently present on the site.

Table 1-2. The screening level risk assessment is supposed to take COIs (see Table 1-1), and through the screening process identify chemicals of potential concern (COPCs). However, Tables 2-1 for soil and Table 2-2 for surface water do not show a complete list of COI. As such, it is not clear all COI were carried through the screening step. DEQ recommends the COI list be reviewed for completeness, and COI screening be presented in the revised ERA using a format similar to NW Natural's 2001 version of the risk assessment document[17]. Lacking this information, DEQ cannot replicate the EPCs presented in the ERA. In addition, screening should be presented in two ways: 1) concentrations at each sampling location (station by station) should be compared to Eco-SSLs and SLVs; and 2) 90% UCLs on the mean values should be presented to represent exposure for mobile receptors over appropriate exposure areas.

Estimates of EPCs should be developed for each of three habitat exposure areas using all data collected to date, as follows:

- Southern Exposure Area - should include:
  - Soil samples from the former tar pond and riverbank areas, including deeper soils samples as outlined in DEQ's general comments above
  - Riverbank samples SS-1, SS-2, SS-2, SS-11, and SS-4, and all pond sediment samples as representative soil (i.e., SD-1, SD-2 and SD-3)

  (Note, pond sediment samples should be considered in EPCs as both terrestrial soil and sediment to account for seasonal flux in pond and wetland water levels.)
- Riverbank Exposure Area - all riverbank samples SS-1 through SS-11
- Northern Exposure Area - Spent Oxide and Riverbank area samples SS-7 and SS-8

[16] NW Natural, 2003, "Removal Action Decision Scoping Document: Former Tar Pond Area, NW Natural – Gasco Facility, 7900 NW St. Helens Road, Portland, Oregon," June 30, a document prepared for NW Natural.
[17] Anchor QEA, LLC, 2001, "Ecological and Human Health Risk Assessment, Level II Screening Report," February, a report prepared for NW Natural.

Section 2.2, page 27. In addition to birds and mammal exposure**;** invertebrates, amphibians, and plants inhabiting the ponds need to be considered in the ERA. It is unknown if a fish community is present in the ponds, but this group should be considered unless NW Natural can document fish are absent throughout the year.

Section 2.2.3, page 30. NW Natural indicates ecological exposure to groundwater is unlikely. DEQ disagrees with this conclusion. There is the potential for terrestrial receptors, including plants and animals to come into contact with contaminated groundwater along the riverbank and in the LNG tanks basin. As discussed in DEQ's comments to the RI Report, site data indicates groundwater in the fill WBZ discharges into the LNG tank basin. Furthermore, groundwater elevation data indicate there is the potential for groundwater in the fill WBZ to discharge onto the riverbank and/or beach areas. Controlling and containing groundwater, including groundwater in the fill WBZ, is an RAO for uplands source control. Additionally, the riverbank is included in the in-water sediment removal/remedial action being overseen by EPA. As such, besides the ERA, DEQ's comment applies to uplands source control and in-water project planning.

In addition, NW Natural should further explain the basis for the comment that, "…there is no well-developed plant community on Site with extensive root systems…." DEQ notes in the seasonal pond, wetland plants are present, and considers this information enough to warrant including plant exposure to surface water in the ERA.

Section 2.3.4, page 31. Exposure to surface water in the ponds should also be included for invertebrates and amphibians. For other receptors (e.g., birds, mammals, amphibians, and reptiles) this includes dermal exposure and the consumption of biological prey from the ponds.

Section 2.5, page 34. This section proposes candidate assessment endpoints. NW Natural should revise the list to include all of the following:

- "protection of mammalian and avian consumers from effects due to COPCs"
- "protection of invertebrate populations from effects due to COPCs"
- "protection of amphibians and reptiles from effects due to COPCs"
- "protection of aquatic and terrestrial plants from effects due to COPCs"

For completeness, this section of the ERA should list receptors with the relevant corresponding exposure pathway(s). DEQ has provided a preliminary list as an example for informational purposes.

- Aquatic invertebrates - pond surface water and sediment
- Amphibians and reptiles - pond and LNG basin surface water and soil/sediment
- Killdeer - site soil, riparian soils, pond sediment, LNG basin sediment, and invertebrate prey (aquatic and terrestrial)
- Kestrel - small mammals from site (body burden modeled from invertebrate prey and soil)
- Shrew - site surface soil (0 to 3.5 feet bgs), riparian soils, pond and LNG basin surface water and sediment; and invertebrate prey

- Mink - site surface soil (0 to 3.5 feet bgs), riparian soils, pond and LNG surface water and sediment, and prey.
- Plants - bioaccumulation in plants is the most relevant for industrial sites with the exception of the riverbank, which should look at direct toxicity (applicable to "greenway" planning).

Section 2.6.1, page 34. For evaluation of COPCs in soil, NW Natural indicates that, "…it was assumed chemicals were evenly distributed across the ecological receptors' habitat and that foraging occurs randomly within this area." However, DEQ understands from Table A-3 the 90th UCL was calculated based on all site soil data, which included non-habitat areas. Exposure point concentrations for mobile receptors (90th UCL on the mean) should be calculated for each habitat area. It should also be made clear how the 90th UCL was calculated (e.g., calculation and statistical methods). NW Natural should include this information in the revised Risk Assessment.

Section 2.6.2, page 35. Each surface water sample should be screened separately for protection of aquatic biota (i.e., aquatic invertebrates). Also, COPCs for surface water should include all chemicals detected. The list should not be limited to "soil COPCs" as is mentioned in this section. The absence of cyanide data in pond water analysis represents a data gap, and absent additional data it should be added to the list of COPCs for the pond areas. As discussed under DEQ's General Comments, sediment samples are also available from the ponds that should be screened in the ERA against DEQ sediment SLVs (DEQ 2001, Table 2).

Table 2-2. DEQ has two comments regarding the data and TRVs used in this table.

- Surface water data should be included here according to individual sampling locations (not 90% UCL values given the limited dataset), and screened with SLVs for protection of aquatic biota, birds (where available), and mammals.
- Chronic TRVs should be selected using the following hierarchy: 1) DEQ Level II Screening Level Values (2001), and 2) Table 1 from *Toxicity Reference Values for Portland Harbor* (EPA 2008). For PAHs, the values presented in Item #2 above should be used instead of DEQ Level II SLVs.

As discussed under DEQ's General Comments, the screening should be completed for all COIs and all receptors, including birds, mammals, and aquatic life. Currently, the table only presents mammalian surface water SLVs for carcinogenic PAHs, and aquatic SLVs for non-carcinogenic PAHs. For example, a mammalian SLV for acenaphthylene of 284 milligrams per liter (mg/L, or parts per million) is presented, when a lower aquatic value of 2.1 ug/L is available (EPA, 2008, citing EPA 2003, *Procedures for the derivation of equilibrium partitioning sediment benchmarks for the protection of benthic organisms: PAH mixtures*). The revised ERA should screen all COIs against aquatic, mammalian, and avian SLVs and Portland Harbor TRVs. Corresponding HQ values should also be calculated as appropriate.

Figure 2-2. Burrowing mammals are exposed to MGP waste and volatile COIs, especially when in burrows. These pathways should be considered complete and significant. In addition, the figure should be revised to show exposure to surface water, pond sediment, and/or wetland soil, are

complete pathways for invertebrate receptors and the organisms that consume them, including migrating water fowl.

General Comments, Section 3 - Human Health Risk Assessment

Exposure Point Concentrations. As discussed in DEQ's comments to the ERA, the Risk Assessment does not present detailed information on the calculation of EPCs, and the subsequent exposure and risk calculations. Therefore DEQ cannot confirm the results. However, it appears from spot checks that at least some risks have been miscalculated. These are more fully discussed in specific comments, but in general the revised HHRA will need to provide the following details:

- Data used for each exposure unit;
- Statistical evaluation of data for each exposure unit (e.g., data distribution and method used to calculate 90% UCL, including handling of non-detect values);
- Equations used for exposure calculations, and results of exposure calculations; and
- Equations used for risk calculations, and results of risk calculations (currently provided)

The spreadsheets used to calculate exposure and risk were provided to DEQ in August 2008. DEQ understands NW Natural revised the spreadsheets from those used for the HHRA. As such, the values calculated by the August 2008 spreadsheets may not exactly match values presented in the HHRA. After reviewing the spreadsheets, DEQ has the following two important general comments.

- Exposure Point Concentration Calculations. The 90% UCL calculations are all conducted assuming the data are normally distributed. The data for each chemical in each exposure unit should be evaluated to determine the appropriate method for calculating the 90% UCL. A spot check of three chemicals showed that they were not normally distributed. Using the techniques available in EPA's ProUCL version 4 program, the 90% UCL for one chemical increased by a factor of 3 or 4, one increased slightly, and the other UCL did not change substantially. It is therefore not clear to DEQ what the overall impact on UCLs will be of a more detailed evaluation of EPCs.
- Soil Ingestion Exposure Calculations. The soil ingestion exposure equations are missing a term. The term for daily exposure frequency (DEF, 250 days/year) is not included. As such, the values are low by a factor of 250, and the resulting soil ingestion risk calculations are also low by a factor of 250. This error does not mean that total risks from soil exposure are off by more than two orders of magnitude because soil risks are a combination of dermal and ingestion risks. However, it is clear that absent this term, soil risks are underestimated.

At this point in the project, DEQ is primarily interested in whether changes to the risk assessment will affect decisions for the uplands FS. Based on the data collected at the site to date, it is clear there are unacceptable risks to workers from exposure to soil in all areas of the site. Three of the five areas would be considered hot spots based on the information in the HHRA. Based on the changes to the spreadsheet from the earlier calculations and the correction of the soil ingestion risk discussed above, the excess lifetime cancer risk for benzo[a]pyrene increased from $2x10^{-5}$ to $2x10^{-4}$, indicating the potential for a fourth area (i.e., the FAMM leasehold area) to be a hot spot. This determination would alter the evaluation of remedial alternatives. It is not clear whether the

revisions to the risk assessment will identify the spent oxide area (the fifth area) as a potential hot spot based on the area EPC. Note however, that hot spots are determined on a point-by-point basis. This means it is likely that some (perhaps many) sample locations in each of the five exposure areas will exceed hot spot levels. Areas of the NW Natural Property exceeding hot spot levels do not need to be delineated in the risk assessment, but will be important in the uplands FS.

DEQ continues to recommend NW Natural consider conducting the HHRA of the NW Natural Property by comparing EPCs to RBCs following the RBDM Guidance. Other elements can be incorporated as needed to complete a Cleanup Program risk assessment (see Appendix J of the RBDM Guidance). As NW Natural and DEQ have discussed during meetings, this could be an effective approach that streamlines the risk assessment process overall, and moves the site forward into the FS more efficiently because the exposure scenarios are standard ones already considered in guidance. For example, although details on the EPC calculations should still be provided, documentation of many of the details regarding the exposure equations will not be required because they are provided in guidance.

Risk of Exposure to MGP Waste. As indicated in DEQ's comments to the RI Report and ERA, the absence of TPH fraction data characterizing the various releases of MGP wastes at the site prevents a complete assessment of human health and ecological risks. Furthermore, it is unclear how the additional data will affect the size and boundaries of areas identified as having unacceptable risk and the delineation of potential "hot spots." In the interest of moving the uplands forward into the FS, DEQ is recommending an approach that: 1) initially relies on existing MGP waste constituent data; 2) focuses additional data collection work on characterizing TPH fractions where needed to support the Risk Assessment; and 3) results in TPH risks being adequately accounted for in the Risk Assessment and addressed in the uplands FS. The approach involves four steps as follows:

1. NW Natural presumes the MGP waste management areas represent potential unacceptable risk to human health.
2. Except for the Tar Pond area, the presence of tar and oil in the upper 3 feet of soil and between 3 feet and 12 feet bgs is identified as potential hot spots with respect to the occupational and construction/excavation worker exposure scenarios respectively. The preliminary hot spot area identified in the removal action scoping document should be used as the starting point for a potential Tar Pond soil hot spot area.
3. Existing site constituent data is used to refine the boundaries of unacceptable risk and potential hot spot areas identified in items #1 and #2.
4. Focused sampling is conducted to further refine the boundaries of unacceptable risk and potential hot spots based on TPH fraction analyses and calculated site-specific TPH RBCs.

The outcome of the process described above are figures depicting the upper 3 feet of soil and soil between 3 and 12 feet bgs showing areas of unacceptable risk and potential hot spots on the NW Natural Property based on MGP waste constituents and TPH fraction data. Portions of the NW Natural Property within the boundaries shown on the two figures should be carried forward into the uplands FS.

Vapor Intrusion Exposure. DEQ has two main vapor intrusion (VI) issues related to the evaluations of occupational and excavation inhalation exposures presented in the HHRA, including NW Natural's choices of appropriate decisions units and the model used for the calculations.

Appropriate Decision Units. The risk of exposure to human health via the VI pathway is dependent on the potential for contamination to impact air quality within individual buildings, either under existing or future conditions. Typically, VI evaluations identify decision units which represent sub-areas of a property with corresponding data sub-sets that are used for the risk assessment. For example, the occupied structures in the Koppers leasehold represent a decision unit for current VI risks. A set of data appropriate for evaluating risk in these buildings from soil and groundwater contamination should be listed in tables and located on figures. Another factor to consider in evaluating the VI pathway is lateral transport of soil vapors. Contamination potentially contributing to VI risks in a building may encompass areas beyond the actual building footprint or defined sub-area of the property. Refer to DEQ's draft guidance[18] on assessing and remediating VI in buildings for additional information.

Unless institutional controls are applied to the property or site conditions preclude building construction, it must be assumed that all areas are available for redevelopment. Therefore, an evaluation of future potential risks must consider all data from portions of the site that can be developed and which are relevant to the VI pathway. Unless development plans are available, and the location and design of future buildings can be specified, potential future VI risks would be a based on a point-by-point comparison with RBCs.

Air dispersion model. Although the Risk Assessment makes reference to transport and exposure equations, the equations used in ASTM Standard E-1739-95 are not presented for DEQ's information and review. In September 2003, DEQ published guidance on assessing VI risks at cleanup sites. Although the transport models in the ASTM Standard are similar to those used in DEQ guidance, they are not identical, particularly with respect to outdoor volatilization. To reduce the time needed to revise the HHRA, DEQ recommends NW Natural use the method described in RBDM Guidance.

The size of an area contributing to outdoor volatilization risks is also an important factor in determining an appropriate RBC for this pathway. Depending on the distribution of contamination across the NW Natural Property, the contributing area may include all subareas (as shown on Figure 1-2). From the standpoint of conducting a comprehensive HHRA of the Gasco Site, the total area of the NW Natural and Siltronic properties (whether contiguous or not) with contamination contributing to outdoor volatilization should be used in the derivation of an RBC. In other words, given NW Natural is conducting separate RIs of each property, the HHRA for the Gasco Site should ultimately look at the cumulative effects of contamination from both properties on outdoor air volatilization.

[18] DEQ, 2009, "Guidance on Assessing and Remediating Vapor Intrusion into Buildings," October, draft guidance prepared by the DEQ.

For NW Natural's information, besides outdoor volatilization, DEQ guidance provides additional information regarding model input parameters and other aspects of interpreting data and assessing risk.

Additional Vapor Intrusion Issues. DEQ has additional comments to the HHRA where evaluation of the VI pathway is concerned, as follows:

- DEQ identified a potential exposure pathway associated with the LNG tank basin that was not assessed in the HHRA and should be included in the revised versions of the document. The LNG basin is approximately 15 feet deeper than the surrounding site topographic surface. Based on monitoring data from nearby fill WBZ wells, the LNG basin overlies a plume of highly contaminated groundwater. The depth of the LNG basin puts on-site workers closer to contaminated groundwater. In addition, the basin's depth could reduce the dispersion of contaminants volatilizing from the underlying soil and groundwater. As such, from a human health exposure perspective, workers in the basin could be exposed to trapped vapors. For purposes of the revising the HHRA, NW Natural should assess this exposure pathway in one of three ways: 1) present a technically based argument for concluding the exposure pathway is incomplete; 2) assess this pathway under conservative exposure assumptions, such as using generic RBCs derived for the "excavation worker exposure to contaminated groundwater" scenario presented in the RBDM Guidance; or 3) develop site-specific RBCs for this pathway that better represent worker exposure within the LNG basin.
- The data summarized in tables A-1 through A-7 do not present the results for the two depth intervals in soil that were to be evaluated separately based on exposure pathways (0 to 3.5 feet bgs; 3.5 to12 feet bgs). It is not clear from the text of the report that the volatilization pathways were evaluated for both shallow and deep soils. DEQ guidance (published prior to the date of this report) does not have a depth threshold that renders the volatilization pathways incomplete, therefore potential risks associated with the VI pathway are evaluated based on data collected over the full depth of the vadose zone.
- Based on the presence of volatile TPH fractions and high concentrations of benzene, naphthalene, and ethylbenzene in some MGP waste, there is a high potential for TPH to screen in as a COPC for VI risks.
- Consistent with DEQ's comments to Section 2.5 of the RI Report, TPH, 1,2,4-TMB, and 1,3,5-TMB should be included in the risk-screening for the vapor pathway.

NW Natural should also be advised DEQ is updating and expanding our guidance on the VI pathway (indoor air only). A draft document was released for public comment in November 2009 and DEQ anticipates finalizing the guidance early in 2010. Soil and groundwater RBCs published in RBDM Guidance will still be used for screening purposes, however, the guidance emphasizes the use of soil gas/sub-slab samples for risk assessment purposes, and the application of generic attenuation factors to determine EPCs and identify hot spots of contamination from a VI perspective (Note, soil gas RBCs for the VI pathway have been added to the RBDM Guidance and can be viewed on-line at http://www.deq.state.or.us/lq/rbdm.htm). The revised Risk Assessment should use the most current version of DEQ guidance.

DEQ Recommendations for Vapor Intrusion. Based on DEQ's review of the RI Report and Risk Assessment, NW Natural should revise the Risk Assessment to incorporate the following recommendations for the indoor air pathway.

- Develop composition-specific ambient air RBCs for the TPH fractions of MGP waste released at the site. These can be derived based on fraction and constituent analyses of either soil or soil vapor samples.
- Review assumptions made in developing generic RBCs for constituents and determine whether published values are appropriate to apply at the NW Natural Property. Use composition-specific TPH RBCs and generic or site-specific constituent RBCs to screen in/out sub-areas of the property with potential indoor VI risks.
- Divide the site into three areas based on current and potential future land use as follows:
  - Area 1: where legal or physical constraints preclude construction of occupied structures. In Area 1 the VI pathway can be considered incomplete.
  - Area 2: the portions of the site where there is the potential for redevelopment but where no occupied structures currently exist. In Area 2 DEQ suggests a risk screening based on soil and groundwater data alone. Additional assessment (i.e. soil gas sampling) if warranted, can be deferred until re-development plans are prepared.
  - Area 3: portions of the site with occupied structures. In Area 3, identify the portion of the site and corresponding data potentially contributing to VI risks at existing buildings. Draft DEQ guidance specifies that data from within 100 lateral feet of buildings should be considered in the risk screening process. If RBCs are exceeded in soil or groundwater (for guidance on screening for TPH VI risk, see below), conduct a soil gas/subslab investigation to determine risks to building occupants and to isolate the contribution of subsurface contamination to inhalation risk. Compare subslab/soil gas results to screening levels based on generic attenuation factors. If a risk is indicated, conduct indoor and outdoor air sampling to determine EPCs or move directly to mitigating VI risks.
- Mitigate or remediate risk if indoor sampling results (corrected for background) indicate acceptable levels are exceeded.

As previously indicated, DEQ has been revising and augmenting guidance on assessing VI risks at hazardous substance cleanup sites. One aspect undergoing revision is the screening of TPH VI risks and associated soil and groundwater RBCs. The language below is taken from draft guidance and describes the approach DEQ expects responsible parties to follow in screening VI risks associated with releases of non-generic TPH products and wastes, including MGP waste.

"For undefined TPH products, wastes and mixtures or for TPH products which generic RBCs have not been developed:

1. Representative soil samples should be analyzed for VPH and/or EPH to determine fraction distribution and to calculate an ambient air RBC.
2. If aliphatic or aromatic fractions of TPH within the C5-C12 range are detected in soil at concentrations greater than 160 mg/kg (residential) or 1,000 mg/kg (commercial), or in groundwater at concentrations greater than 2 mg/L (residential) or 12 mg/L (commercial), then further VI assessment is warranted and soil gas samples should be collected.

3. A site-specific soil gas RBC is calculated by multiplying the ambient air RBC determined in step 1 by the appropriate attenuation factor (200 for residential, 1,000 for commercial)
4. Compare soil gas data to the site-specific soil gas RBC to determine whether contaminant levels warrant indoor air sampling and/or implementing vapor mitigation."

Outdoor Air Volatilization Pathway. Regarding the outdoor volatilization pathway, DEQ expects NW Natural to:

- Review the model and assumptions used in the RBDM Guidance to evaluate exposure from outdoor volatilization from soil and groundwater contamination (i.e., the *Soil Screening Guidance: Technical Background*, EPA 1996, EPA/540/R-95/128).
- Develop site-specific model input parameters, as the default assumptions in the RBDM Guidance do not apply to MGP waste at the NW Natural Property for the reasons discussed above.
- Use the sum of all source areas, whether contiguous or not, as the total area contributing to outdoor volatilization on the NW Natural Property.

NW Natural should be aware the overall assessment of the outdoor volatilization pathway for the Gasco Site will ultimately need to include contributions from the NW Natural and Siltronic properties.

Specific Comments, Human Health Risk Assessment

Section 1, page 1. Contrary to the seventh bulleted item, DEQ considers this report to present a baseline HHRA, not a baseline Level III HHRA.

Figure 1-2. The site boundary and the risk assessment boundary cannot be distinguished. The figure should be revised for the next version of the Risk Assessment.

Section 1.3, page 21. The Risk Assessment indicates the Siltronic Property is not included in the Gasco Site LOF. For clarification, the Gasco Site LOF should include the area where receptors can come into contact with MGP waste and/or contamination on both the NW Natural and Siltronic properties. In addition, as indicated in DEQ's comments to Section 8.1 of the RI Report, contamination associated with the former Gasco MGP extend offshore of the NW Natural Property and northern portion of the Siltronic Property, and may have impacted the U.S. Moorings site.

Section 1.4, page 21, and Table 1-2. The COPCs identified in the HHRA are based on screening conducted in 2001. Given the draft RI report was submitted in 2007 and the COI list has been modified since then, the risk assessment report should be revised based on currently available site chemical concentrations and currently available toxicity information. For example, EPA provides Regional Screening Levels (RSLs)[19] for cyanide compounds in soil, air, and groundwater. Appropriate screening values for cyanide compounds, including for the vapor intrusion pathway, should be proposed and discussed with DEQ as part of the COI screening process. NW Natural

[19] http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

should document the revised COI screening analysis in an interim submittal to be provided to DEQ for review and comment.

Table 1-1. Chromium IV is likely intended to be chromium VI. Table 1-2 needs to be corrected for this reason as well. This table also inadvertently includes antimony, arsenic, beryllium, and cadmium in the list of monocyclic aromatics and should be revised accordingly.

Section 3.1.2, pages 45 and 48 (Exposure Scenarios). A construction worker scenario is not included in the HHRA, although this is a reasonable exposure scenario for the NW Natural Property. The rationale for excluding this exposure scenario should be provided; otherwise the report should be revised to include the scenario. Figure 3-1 also does not include a construction worker exposure scenario and should be revised as appropriate.

Section 3.1.2, page 49 (Occupational Scenario). It is not clear to DEQ whether outdoor inhalation from soil is for surface soil or subsurface soil. Also, the indoor air inhalation route is limited to groundwater. Both soil and groundwater should be evaluated for vapor transport. NW Natural should provide information to clarify and/or address these comments.

Section 3.2.1, Page 52. Based on assumptions of normality and log-normality made by NW Natural, the most conservative upper confidence limit (UCL) was selected for use. It is more appropriate to evaluate the distribution of data and then select the appropriate method to calculate the UCL on the arithmetic mean. EPA's ProUCL program can be used to aid in the determination of distributions and calculation of UCLs. The ProUCL software is available for download at http://www.epa.gov/nerlesd1/tsc/software.htm.

Figure 3-1. Evaluating air exposure from occupation/excavation and excavation appears to be redundant and should be explained. In addition, NW Natural should clarify whether inhalation via groundwater is not included because it is addressed by the air pathway. The box at the bottom of the figure referring to the Aquatic Ecological Risk Assessment likely should refer to the Portland Harbor in-water HHRA.

Figure 3-2. NW Natural should clearly indicate how the re-development areas relate to the human health exposure units. NW Natural should also be advised that unless institutional controls are applied to the NW Natural Property, it must be assumed that all areas are available for redevelopment. Therefore, an evaluation of future potential risks must consider all data from portions of the site that can be developed and which are relevant to the VI pathway. Unless development plans are available, and the location and design of a future building can be specified, potential future VI risks would be based on a point-by-point comparison with RBCs.

Section 3.2.3, page 55. The ingestion of groundwater in an excavation is considered insignificant, and is not a required route as shown on Figure 3-2. The vapor factor for an excavation is presented in RBDM Guidance.

Tables 3-2 to 3-7. These tables should be revised so excess lifetime cancer risk (ELCR) values are reported to only one significant digit. For example, an ELCR of 2.8E-6 should be presented as 3E-6. In addition, a value of "0.00E00" should not be included in the table. Lastly, if chemicals are not present in an area this should be discussed in the text of the Risk Assessment and an explanatory footnote with this information should be added to the tables. Tables 3-5 and 3-6 should also be reviewed for printing errors.

Section 3.5.2, page 68 (Occupation Inhalation Exposures). NW Natural should be aware that default values for soil contact, including frequency of contact are available. As discussed above in DEQ's comment to Section 3.2.3, ingestion of groundwater by workers in the subsurface is not considered significant.

Section 3.5.3, page 69. DEQ disagrees with NW Natural's description of the uncertainty of toxicity values as being low. The confidence in toxicity factors varies, and in many cases there is high uncertainty.

Section 3.5.3, Page 70 (Estimated Toxicity Values). The use of unmodified oral toxicity factors for dermal toxicity factors can result in substantial underestimates of potential risks. It will not result in overestimates of risk. This is because dermal toxicity factors are based on absorbed dose and oral toxicity factors are based on administered dose. For example, looking at the gastrointestinal (GI) absorption factors (not dermal) taken from RAIS, the GI absorption of chromium VI (not chromium IV) is 0.02. This means that 98 percent of the chemical was eliminated without absorption, and the observed toxic effects were due to the 2 percent of the dose that was absorbed. Therefore, the toxicity of the absorbed dose is 50 times that of the administered dose, and the dermal toxicity factor should be 50 times the oral toxicity factor. EPA's approach in the "Risk Assessment Guide for Superfund" Part E is to not adjust oral toxicity factors used as dermal toxicity factors if the GI absorption is greater than 50 percent. Given the uncertainties, EPA is willing to accept that dermal risks may be underestimated by a factor of 2. But for GI absorptions less than 50 percent, the correction for a dermal toxicity factor based on absorbed dose should be made.

Table 3-8. The source of the variance estimates is unclear to DEQ. In particular, the choice of 0.2 times the RME for the source area is not justified. These estimates appear to be based on professional judgments, and should be stated as such. Additionally, the default percent crack value should be 0.001, not 0.0001 as shown in Table B-2. NW Natural should note, if DEQ's new VI guidance is followed, this factor does not need to be used (i.e., new guidance makes this factor essentially obsolete).

Figures 3-3 and 3-4. If the "uncertainty estimates" for each of the parameters represent the low end of the range, then they should be characterized as "low end."

Section 3.5.4, page 75. The statement "…the results for occupational carcinogenic risks fall below 1×10^{-5} …" should be clarified to indicate whether this refers to individual chemical risks or cumulative risks. The term "minimal risk" is not defined and should be avoided. If the primary

contribution to risk is from one chemical, DEQ will not consider an excess lifetime cancer risk of 10^{-5} as being minimal risk given the value is an order of magnitude greater than the acceptable risk level for individual substances.

Section 4.2, page 76. The results of using "reasonable alternate assumptions" presented here will be considered as part of the uncertainty analysis. DEQ rules call for remediation decisions to be based on RME calculations, with central tendency exposure (CTE) considered under special circumstances.

Section 4.2, page 77. Given the context of the last paragraph, the last sentence may imply that development of the site will reduce risks. On the contrary, lack of future development plans highlights the importance of adequately characterizing potential risks at the site.

Appendix A

Table A-1. Statistics are not provided by area. Revise the report to include the distributions and EPC calculations by area (based on the revised spreadsheets provided to DEQ in August 2008).

Table A-2. Explain how UCL calculations were performed on data that were 75 percent not detected. Recent revisions to EPA's ProUCL program (version 4.0) address the issue of assessing non-detect values in the development of UCLs. Also, data for benzene, toluene, ethylbenzene, and xylenes should be screened by area.

Tables A-2 and A-3. It appears UCLs were calculated for the entire site, not by area. Provide the statistical information for each exposure area evaluated in the risk assessment

Table A-6. NW Natural should explain how the groundwater concentration means and UCLs were calculated, including which monitoring wells were used, and over what time period. Without good representative EPCs, the resulting risk calculations are not relevant.

Appendix B

Table B-1. It is acceptable to use the CTE value of 3,300 cm^2 for the RME value according to RBDM Guidance.

Table B-2. The RME values indicated as "NA" should instead show that the CTE values will be used. The inhalation rate (IRA) should be 20 m^3/day for both RME and CTE, not 15.2 m^3/day as shown. This value is consistent with EPA's default exposure value, which is used to convert reference concentrations to reference doses, and inhalation unit risk factors to slope factors. If a lower inhalation rate is used (e.g., 15.2 m^3/day) the value should be justified and readily available reference doses and slope factors need to be adjusted accordingly. In addition, the table provides parameter values pertaining to buildings as used in VI calculations, but information on subsurface conditions (i.e. air-filled, water-filled porosity) is not included. For completeness, values for all the parameters used in the calculations should be presented.

Table B-3. It is acceptable to use the CTE value of 3,300 cm^2 for the RME value. The RME value for the ingestion rate of soil should be 330 mg/day, not 480 mg/day. See the RBDM Guidance for current guidance regarding exposure factors.

Table B-4. The RME values indicated as "NA" should instead show that the CTE values will be used. Additionally, CTE and RME values need to be provided for the second, third, and fourth parameters listed in the table.

Table B-5. Provide the reference for "EPA 1992." Also, it is acceptable to omit the dermal adsorption factor (i.e., DAF = 0) for the volatile chemicals benzene, xylenes, and naphthalene.

Appendix C

In general, the COI list and corresponding toxicity values used in the Risk Assessment should be checked for updates since the risk assessment was submitted. As noted previously in this letter, TPH, 1,2,4-TMB, and 1,3,5-TMB should be added to the COI list. Regarding toxicity, there were significant revisions to the evaluations of ethylbenzene (Section 1.3, page C-1) and naphthalene (Section 1.17, page C-16), both of which are now evaluated as carcinogens. In addition, as mentioned under DEQ's comment to Section 1.4, EPA RSLs are available for cyanide compounds.

Page C-23. NW Natural should not use the assumption that the ratio of chromium III to chromium VI is 1:6. Instead, evaluate each form of chromium separately. Separate toxicity factors are provided in DEQ's RBDM Guidance and EPA's RSL tables. If data is lacking for chromium III and chromium VI, then NW Natural should acknowledge this in the Risk Assessment and discuss the topic further in the uncertainty section.

Table C-1. The oral slope factor for dibenzo[a,h]anthracene should be 7.3 $(mg/kg/day)^{-1}$, not 0.073 $(mg/kg/day)^{-1}$. The correct value for the slope factor is noted in the text.

Appendix D

Appendix D or another appendix should present the results of the exposure assessment. See the above general comments on the calculation of EPCs in the risk assessment. If risk calculations are performed by comparing concentrations to acceptable values such as site-specific RBCs, tables of calculated doses are not needed.

In general, excess lifetime cancer risk values should be reported to only one significant digit. The HQ values should be presented to two significant digits. A value of "0.00E00" should not be included in risk tables. If chemicals are not present in an area, an explanatory footnote should be added to the table communicating this information.

NEXT STEPS

Given NW Natural's and DEQ's mutual goal of completing the Risk Assessment and moving forward with the FS, DEQ is not requiring the RI Report to be revised and resubmitted. DEQ will require NW Natural to provide the requested information items in a letter responding to DEQ's comments. The letter should also confirm that DEQ's comments will be incorporated into future submittals as appropriate, including but not necessarily limited to the Risk Assessment, SCMs documents, and/or the uplands FS.

DEQ requires NW Natural to revise and resubmit the Risk Assessment. In the interest of finalizing the Risk Assessment as efficiently as practicable, DEQ will also require NW Natural to closely coordinate with DEQ early in, and during the Risk Assessment revision process. Before revising the ERA, NW Natural must provide DEQ with information for conducting the Level II ERA, including but not necessarily limited to:

- A table showing COI and toxicity reference values for each receptor class of interest (e.g., bird, mammal, amphibian/reptile, plants, aquatic biota) and media of interest (e.g., soil, sediment, surface water).
- A table and map showing the designations of habitat exposure areas and samples to be used in the calculation of EPCs in the revised ERA. As previously discussed, samples used to calculate EPCs should include deeper samples (e.g. 5 to 6 feet and 11 feet bgs) in order to address uncertainty in the current 0 to 0.2 feet dataset. This should clearly indicate which samples fall within each habitat area for each receptor of interest. Sample characteristics such as depth collected and analyte list should be presented.
- A figure delineating where on the site MGP waste occurs in the upper 3.5 feet of soil with tar and/or oil occurrence and habitat areas highlighted.
- Calculation of exposure point concentrations

To facilitate preparation and review of the revised HHRA, NW Natural should provide the following interim submittals to DEQ:

- Screening of the updated COI list using current toxicity information
- Establishment of datasets for exposure units, including figures showing where on the site MGP waste occurs in the upper 3 feet and upper 12 feet of soil with tar and/or oil occurrence highlighted
- Calculation of exposure point concentrations

The interim submittals can take the form of brief memoranda, with associated tables, figures, and spreadsheets, as appropriate.

Review and comment by DEQ of the ERA memorandum and HHRA interim submittals will provide NW Natural with feedback, identify information needs, and clarify expectations while the Risk Assessment is being revised. The overall goal of this process is to produce a document that is in near final form when submitted.

NW Natural and DEQ should meet as soon as practicable to discuss DEQ's comments regarding the ERA and HHRA, and to develop a schedule for completing the Risk Assessment, including preparation of the ERA memorandum and HHRA interim submittals.

Please call me at (503) 229-5543 if you have questions regarding this letter.

Sincerely,

Dana Bayuk, Project Manager
NWR Cleanup Section

Attachment: Table 1

Cc:

Patty Dost, Pearl Legal Group
John Edwards, Anchor QEA, LLC
Carl Stivers, Anchor QEA, LLC
Rob Ede, Hahn and Associates, Inc.
Myron Burr, Siltronic
Tom McCue, Siltronic
Alan Gladstone, Davis Rothwell Earle & Xochihua, P.C.
James Peale, MFA
Jennifer Peers, Stratus Consulting, Inc.
Eric Blischke, EPA
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Chip Humphries, EPA
Kristine Koch, EPA
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Lance Peterson, CDM
Jim Anderson, DEQ/PHS
Tom Gainer, DEQ/PHS
Henning Larsen, DEQ/SRS
Matt McClincy, DEQ/PHS
Jennifer Peterson, DEQ/PHS
Mike Poulsen, DEQ/PHS
ECSI file nos. 84 and 183